

# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **PEQUAWKET POND, CONWAY**, the program coordinators have made the following observations and recommendations:

Welcome back to the New Hampshire Volunteer Lake Assessment Program! As your group continues to participate in VLAP over the years, the database created for your pond will help your monitoring group track water quality trends and will ultimately enable your group and DES to identify potential sources of pollutants from the watershed that may affect pond quality.

As a rule of thumb, *please* try to sample at least once per month during the summer months (**June, July, and August**). In addition, it may be necessary to conduct rain event sampling at multiple locations along a stream using the bracketing technique to pinpoint sources of pollution. Furthermore, baseline studies could involve bi-weekly or monthly sampling for an extended period of time. DES will let you know if this type of sampling is appropriate.

We understand that future sampling will depend upon volunteer availability, and your group's water monitoring goals and funding availability. We would like to point out that **water quality trend analysis is not feasible with only a few data points**. It will take many years to develop a statistically sound set of water quality baseline data. Specifically, after 10 consecutive years of participation in the program, we will be able to analyze the in-lake data with a simple statistical test to determine if there has been a significant change in the annual mean chlorophyll-a concentration, Secchi-disk transparency reading, and phosphorus concentration. Therefore, frequent and consistent sampling will ensure useful data for future analyses.

Please contact the VLAP Coordinator early this spring to schedule the annual DES lake visit. **It would best to schedule the DES visit for early June to refresh your sampling skills!**

We encourage your monitoring group to formally participate in the DES Weed Watchers program, a volunteer program dedicated to monitoring lakes and ponds for the presence of exotic aquatic plants. This program only involves a small amount of time during the summer months. Volunteers survey their waterbody once a month from **June** through **September**. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the waterbody and any islands it may contain. Using the materials provided in the Weed Watchers Kit, volunteers look for any species that are of suspicion. After a trip or two around the waterbody, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers will send a specimen to DES for identification. If the plant specimen is an exotic, a biologist will visit the site to determine the extent of the problem and to formulate a management plan to control the nuisance infestation. Remember that early detection is the key to controlling the spread of exotic plants.

If you would like to help protect your lake or pond from exotic plant infestations, contact Amy Smagula, Exotic Species Program Coordinator, at 271-2248 or visit the Weed Watchers web page at [www.des.state.nh.us/wmb/exoticspecies/survey.htm](http://www.des.state.nh.us/wmb/exoticspecies/survey.htm).

#### **FIGURE INTERPRETATION**

- **Figure 1 and Table 1:** Figure 1 (Appendix A) shows the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the pond has been monitored through VLAP.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m<sup>3</sup>.**

The current year data (the top graph) show that the chlorophyll-a concentration on the **July** sampling event was **less than** the state median and the similar lake median (for more information on the similar lake median, refer to Appendix F).

Overall, visual inspection of the historical data trend line (the bottom graph) shows a **relatively stable** in-lake chlorophyll-a trend since monitoring began in 2001. However, please keep in mind that this

trend is based on limited data since the pond was sampled once during 2001, 2003, and 2005 and was not sampled during 2002 and 2004.

As your group expands its sampling program to include additional events each year and samples year after year, we will be able to determine trends with more accuracy and confidence. After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

While algae are naturally present in all ponds, an excessive or increasing amount of any type is not welcomed. In freshwater ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase (such as sediment phosphorus releases, known as internal loading). Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about activities within the watershed that affect phosphorus loading and pond quality.

- **Figure 2 and Table 3:** Figure 2 (Appendix A) shows the historical and current year data for pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the pond has been monitored through VLAP.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

The current year data (the top graph) show that the in-lake transparency on the **July** sampling event was **less than** the state median and the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, visual inspection of the historical data trend line (the bottom graph) shows a **decreasing, meaning worsening**, transparency trend since monitoring began in 2001. Again, please keep in mind that this trend is based on only **three** sample results. As previously discussed, after 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to

objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes sediment erosion to flow into ponds and streams, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the pond has joined VLAP.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Excessive phosphorus in a pond can lead to increased plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion show that the phosphorus concentration on the **July** sampling event was *slightly less than* the state median and was *greater than* the similar lake median (refer to Appendix F for more information about the similar lake median).

The current year data for the hypolimnion show that the phosphorus concentration on the **July** sampling event was *less than* the state median and the similar lake median (refer to Appendix F for more information about the similar lake median).

Overall, visual inspection of the historical data trend line for the epilimnion shows an *increasing, meaning worsening*, phosphorus trend since monitoring began in **2001**.

Overall, visual inspection of the historical data trend line for the hypolimnion shows a *relatively stable* phosphorus trend which is *less than* the state median and similar lake median since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and the recreational, economical, and ecological value of lakes and ponds. Phosphorus sources within a pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

#### **TABLE INTERPRETATION**

➤ **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the pond. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample.

Due to an equipment problem, a phytoplankton sample was not collected on the **July** sampling event. Typically, the dominant phytoplankton species at the deep spot are golden-brown algae and diatoms.

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The pH at the deep spot on the **July** sampling event ranged from **6.08** in the hypolimnion to **6.78** in the epilimnion, which means that the water is ***slightly acidic***.

It is important to point out that the pH in the hypolimnion (lower layer) was **lower (more acidic)** than in the epilimnion (upper layer). This increase in acidity near the lake bottom is likely due the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the presence of granite bedrock in the state and acid deposition (from snowmelt, rainfall, and atmospheric particulates) in New Hampshire, there is not much that can be done to effectively increase pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the pond has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) on the **July** sampling event was **6.8 mg/L**, which is **greater than** the state median. In addition, this indicates that the pond is **moderately vulnerable** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current (which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column). The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity in the epilimnion at the deep spot on the July sampling event was **69.19 uMhos/cm**, which is **greater than** the state median.

The conductivity has **fluctuated** in the pond and tributaries since monitoring began, but has been greater than the state mean on all

sampling events. Typically, sources of **elevated** conductivity are due to human activity. These activities include failed or marginally functioning septic systems, agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron and manganese deposits in bedrock, can influence conductivity.

It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the pond. The most commonly used de-icing material in New Hampshire is salt (sodium chloride).

Therefore, we recommend that the **epilimnion** and the major inlets be sampled for chloride next season. This sampling may help us pinpoint what areas of the watershed are contributing to the elevated in-lake conductivity.

*Please note that there will be an additional cost for each of the chloride samples and that these samples must be analyzed at the DES laboratory in Concord. In addition, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.*

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The phosphorus concentration in the **Inlet** and **Outlet** was **relatively low** on the **July** sampling event, which is good news. However, we recommend that your monitoring group sample the major tributaries to the pond soon after snow-melt and periodically during rain storms to determine if the phosphorus concentration is **elevated** in the tributaries during these times. Typically, the majority of nutrient loading to a pond occurs in the spring during snowmelt and during intense rain storms that cause surface runoff and erosion within the watershed.

*For a detailed explanation on how to conduct rain event sampling please refer to the 2002 VLAP Annual Report "Special Topic Article" or contact the VLAP Coordinator.*

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2005 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The dissolved oxygen concentration was ***lower in the hypolimnion (lower layer) than in the epilimnion (upper layer)*** at the deep spot of the pond on the **July** sampling event. As stratified ponds age, and as the summer progresses, oxygen typically becomes ***depleted*** in the hypolimnion by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion, the phosphorus that is normally bound up in the sediment may be re-released into the water column (a process referred to as ***internal phosphorus loading***).

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The tributary and deep spot turbidity was ***relatively low*** this season which suggests that erosion may not be a major contributor of sediment and nutrient loading to the pond. This is good news and we hope to see this trend continue.

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 lists the current year and historical data for bacteria (*E.coli*) testing. (Please note that Table 12 now lists the maximum and minimum results for this season and for all past sampling seasons.) *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms **MAY** also be present.



The *E. coli* concentration was **very low** at the **Beach** on the **July** sampling event. Specifically, the result was **7 counts**, which is ***much less than*** the state standard of 88 counts per 100 mL for surface waters that are designated public beaches.

If you are concerned about bacteria levels at this beach, you may want to repeat this test next season on a weekend during heavy beach use or after a rain event. Since *E.coli* die quickly in cool pond waters, testing is most accurate and most representative of the health risk to bathers when the source (humans, animals, or waterfowl) is present.

➤ **Table 14: Current Year Biological and Chemical Raw Data**

This table lists the most current sampling season results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year “raw” (meaning unprocessed) data. The results are sorted by station, depth zone (epilimnion, metalimnion, and hypolimnion) and parameter.

➤ **Table 15: Station Table**

As of the Spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past (and are most familiar with), an EMD station name also exists for each VLAP sampling location. For each station sampled at your pond, Table 15 identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

### **DATA QUALITY ASSURANCE AND CONTROL**

#### **Annual Assessment Audit:**

During the annual visit to your pond, the biologist conducted a “Sampling Procedures Assessment Audit” for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors fail to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors

as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group performed **very well** while collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures. The biologist identified one aspect regarding sample collection that the volunteer monitors could improve upon.

- **Anchoring at deep spot:** Please remember to use an anchor with sufficient weight and sufficient amount of rope to prevent the boat from drifting while sampling at the deep spot. It is difficult for the biologist to collect an accurate and representative dissolved oxygen/temperature profile when the boat is drifting. In addition, it is difficult to view the Secchi disk and collect samples from the proper depths when the boat is drifting. Depending on the depth of the pond and the wind conditions, it may be necessary to use two anchors!

#### **USEFUL RESOURCES**

*Acid Deposition Impacting New Hampshire's Ecosystems*, NHDES Fact Sheet ARD-32, (603) 271-2975 or [www.des.state.nh.us/factsheets/ard/ard-32.htm](http://www.des.state.nh.us/factsheets/ard/ard-32.htm).

*Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials*, NHDES Booklet WD-03-42, (603) 271-2975.

*Canada Geese Facts and Management Options*, NHDES Fact Sheet BB-53, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-53.htm](http://www.des.state.nh.us/factsheets/bb/bb-53.htm).

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms*, NHDES Fact Sheet WMB-10, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-10.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-10.htm).

*Erosion Control for Construction in the Protected Shoreland Buffer Zone*, NHDES Fact Sheet WD-SP-1, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-1.htm](http://www.des.state.nh.us/factsheets/sp/sp-1.htm).

*Impacts of Development Upon Stormwater Runoff*, NHDES Fact Sheet WD-WQE-7, (603) 271-2975 or [www.des.state.nh.us/factsheets/wqe/wqe-7.htm](http://www.des.state.nh.us/factsheets/wqe/wqe-7.htm).

*IPM: An Alternative to Pesticides*, NHDES Fact Sheet WD-SP-3, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-3.htm](http://www.des.state.nh.us/factsheets/sp/sp-3.htm).

*Iron Bacteria in Surface Water*, NHDES Fact Sheet WD-BB-18, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-18.htm](http://www.des.state.nh.us/factsheets/bb/bb-18.htm).

*Lake Foam*, NHDES Fact Sheet WD-BB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-5.htm](http://www.des.state.nh.us/factsheets/bb/bb-5.htm).

*Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes*, NHDES Fact Sheet WD-BB-9, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-9.htm](http://www.des.state.nh.us/factsheets/bb/bb-9.htm).

*Low Impact Development: Taking Steps to Protect New Hampshire's Surface Waters* NHDES Fact Sheet WD-WMB-16, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-17.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-17.htm).

*Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act*, NHDES Fact Sheet WD-SP-2, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-2.htm](http://www.des.state.nh.us/factsheets/sp/sp-2.htm).

*Road Salt and Water Quality*, NHDES Fact Sheet WD-WMB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-4.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-4.htm).

*Sand Dumping - Beach Construction*, NHDES Fact Sheet WD-BB-15, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-15.htm](http://www.des.state.nh.us/factsheets/bb/bb-15.htm).

*Shorelands Under the Jurisdiction of the Comprehensive Shoreland Protection Act*, NHDES Fact Sheet SP-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-4.htm](http://www.des.state.nh.us/factsheets/sp/sp-4.htm).

*Soil Erosion and Sediment Control on Construction Sites*, NHDES Fact Sheet WQE-6, (603) 271-2975 or [www.des.state.nh.us/factsheets/wqe/wqe-6.htm](http://www.des.state.nh.us/factsheets/wqe/wqe-6.htm).

*Swimmers Itch*, NHDES Fact Sheet WD-BB-2, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-2.htm](http://www.des.state.nh.us/factsheets/bb/bb-2.htm).

*Through the Looking Glass: A Field Guide to Aquatic Plants*, North American Lake Management Society, 1988, (608) 233-2836 or [www.nalms.org](http://www.nalms.org).

*Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants*, NHDES Fact Sheet WD-BB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-4.htm](http://www.des.state.nh.us/factsheets/bb/bb-4.htm).

*Watershed Districts and Ordinances*, NHDES Fact Sheet WD-WMB-16, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-16.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-16.htm).